CITY OF SCOTTSDALE

Drainage Reports

PRELIMINARY DRAINAGE REPORT
FOR
10535 E SHAW BUTTE DRIVE

Plan # _____

Case # 11-PP-2019

Q-S # _____

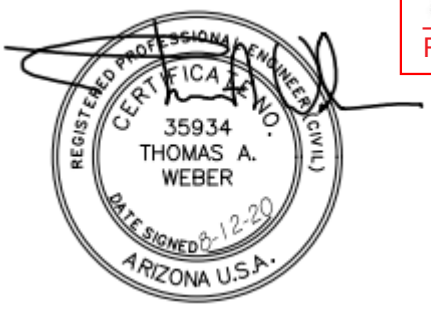
X Accepted

____ Corrections

09/28/2020

Reviewed By Date

September 9, 2020



CLOUSE ENGINEERING, INC.
JOB NO. 190908

CITY OF SCOTTSDALE #11-PP-2019

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1.0 INTRODUCTION

1.1 PURPOSE/SCOPE

10535 E SHAW BUTTE is a proposed 2 lot subdivision encompassing approximately 2.5 acres within the City of Scottsdale. The purpose of this report is to define current and proposed drainage conditions for the project site.

1.2 SITE LOCATION

The proposed 2 lot subdivision is located within the City of Scottsdale and is located on the west side of 106th Street alignment and just south of Cactus Road. Legally the site lies in a portion of the S.W. ¼ of Section 21, T. 3N., R. 5E., G. & S. R. B. & M., Maricopa County, Arizona. Figure 1.1 illustrates the site's location.

1.3 SITE TOPOGRAPHY

The site is currently open desert rangeland with a single structure. The site drains to the southwest at an average slope of 2.90 percent.

1.4 F.I.R.M. Map

The single-family home is currently in Zone X and A, as established by the F.I.R.M. for Maricopa County Map Number 04013C1780-L with an effective date of October 16, 2013. Refer to Figure 1.2 for the location of the site on the F.I.R.M. map.

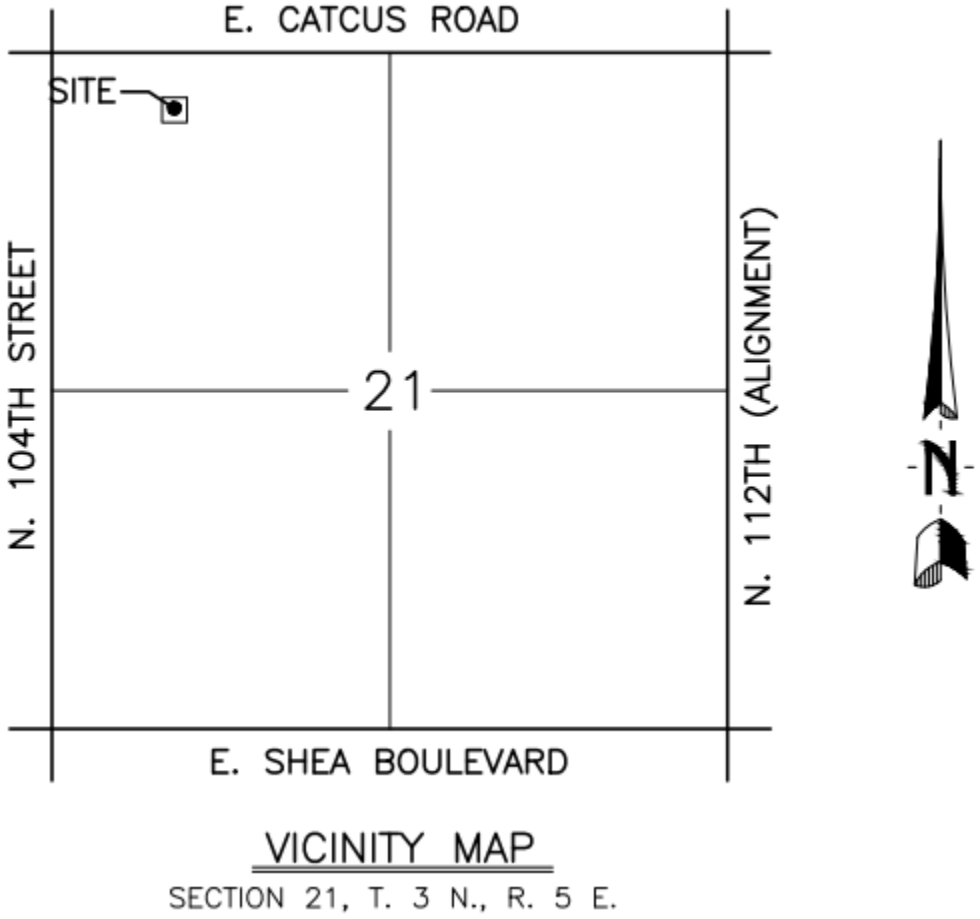


Figure 1.1 – Site Location

National Flood Hazard Layer FIRMette

FEMA

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/17/2019 at 5:58:32 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

2.0 DRAINAGE CONCEPTS

2.1 EXISTING CONDITIONS

The project site is an existing two-acre single-family lot surrounded by existing single-family homes on all sides. The surrounding area consists of large residential homes with most historic drainage ways left in place. Runoff in the area travels from north to south, southwest collecting within the historic drainage ways. Homes to the north east of the site have provided recorded drainage ways and opening on their properties to allow historic flows to pass through. The properties to the south of the subject property have provided recorded drainage easements to allow runoff to cross into and out of the 106th Street alignment from east to west. Offsite runoff drains to the project site at the northeast, northwest, and southeast corners of the site. The flows that enter at the northeast corner of the site historically drain south within the 106th Street right of way in an existing unnamed wash. These flows are joined at the south east corner of the site by flows entering the same unnamed wash discharged from the Montagna Vistas subdivision. This combined flow continues south for a short distance before draining west to a drainage way within the Bella Montagna subdivision.

The flows that enter the site at the northwest corner of the site pass through the site in a poorly defined wash before entering the parcel to the immediately south of the site.

Runoff generated on the site historically has drained to both the southeast and southwest corners of the site based on existing topography. The property immediately to the west though has constructed masonry walls along their property line blocking the historical outfall for a portion of the site. The property to the south has a drainage easement dedicated to allow offsite flows to enter. The drainage easement is shown on the preliminary grading and drainage plan.

2.2 PROPOSED CONDITIONS

The developed site will consist of two single family home sites with the same zoning as is currently in place. Roadway improvements will be provided for 106th Street along with the Paradise Drive alignment. These improvements will include an all-weather road for both roadways. The historical offsite runoff will be conveyed on the east side of 106th Street along its

historical location. The offsite runoff will be conveyed in an engineered drainage channel. Further details on the drainage channel are provided in the HYDRAULICS section of the report.

The individual lots will be designed to drain north to south retaining the 100-year, 2-hour storm event on each of the individual lots. The finish floors on each of the lot will be set a minimum of 1-foot above the 100-year water surface. The ultimate outfall for the lots will be at the southeast corner of the property.

3.0 HYDROLOGY

3.1 OFFSITE

Offsite peak flows will be calculated using the Rational Method:

$$Q = c\ i\ A$$

Where:

Q = peak runoff (cfs)
c = runoff coefficient
i = rainfall intensity (in/hr)
A = contributing drainage area (ac)

As previously mentioned, offsite runoff approaches the site from the north and enters the site along the north line of the site and the southeast corner of the site . The offsite flows draining to the site come primarily from upstream residential areas that have not provided retention. The offsite drainage areas are highlighted on the enclosed Offsite Drainage Map. A runoff coefficient of 0.60 was utilized for the 100-year flow calculation based on the County's Table 3.2 with a low-density residential coverage for the runoff area. Rainfall intensity was calculated utilizing the County's Time of Concentration (Tc) formula 3.2. Tables for the runoff coefficient and Intensity-Duration graphs are included in the Appendix for reference. Table 3.1 below summarizes the offsite runoff calculations.

Point of Conc.	Area (ac)	Runoff Coefficient	Time of Concentration (min)	Rainfall Intensity	Q_{100} (cfs)
A	28.67	0.60	7.5	6.38	109.7
B	14.10	0.60	7.5	6.38	54.0
C	4.40	0.60	5.0	7.60	20.1

Table 3.1 – Offsite Runoff Summary

3.2 PRE-& POST DEVELOPMENT RUNOFF CALCULATIONS

3.2.1 Pre-Development

The pre-development runoff from the site is calculated utilizing the Rational Calculations with a runoff coefficient of 0.50 for undeveloped desert rangeland and the County's Tc formula 3.2 A summary of the peak pre-development runoff is presented below.

Point of Conc.	Area (ac)	Runoff Coefficient	Time of Concentration (min)	Rainfall Intensity	Q_{100} (cfs)
Outfall	2.5	0.50	5	7.6	9.5

Table 3.2 – Offsite Runoff Summary

3.2.2 Post-Development

The post-development flows are based upon the Maricopa County design storm distributions as detailed in Section 2.4 of the Maricopa County Hydrology Manual. Specifically, the 100-year, 6-hour storm distribution was used utilizing Pattern 1 with a rainfall value of 2.8-inches for the specified rainfall event. A copy of the distribution mass curve and Isopluvial map are provided in the Appendix for reference.

Based on the storm distribution and mass curve, the rainfall volume generated for the site was calculated at 15-minute intervals and compared against the retention volume provided on the site. The peak rainfall intensity for post-development conditions would be the rainfall intensity remaining at the time the retention basins on-site were full. This peak rainfall intensity would be utilized to calculate the post-development runoff. A copy of these calculations are provided in the Appendix.

Table 3.3 below summarizes the peak flow calculations for the site. Additional calculations are provided in the Appendix.

Point of Conc.	Area (ac)	Runoff Coefficient	Time of Concentration (hours)	Rainfall Intensity	Q_{100} (cfs)
Outfall	2.5	0.60	3.92	2.96	4.44

Table 3.3 – Offsite Runoff Summary

Based upon the above calculations, the post-development flow discharged (4.44-cfs) is less than the pre-development flow (9.5cfs).

4.0 HYDRAULICS

4.1 DRAINAGE CHANNEL

The proposed development has existing runoff entering at the northeast corner of the site and draining south to an existing drainage opening on the west side of 106th Street. As a part of the improvements for this project, a drainage channel is proposed to convey the offsite flows along the east side of the project site in the same corridor as they currently flow. The channel will be designed with a maximum of 4:1 side slopes and a 2-foot bottom. The channel will collect flow that enter at the northeast and southeast corner of the site. Just south of the site, 106th Street will be designed to be one-way to allow flow to sheet across the road from east to west to enter the existing drainage way in the Bella Montagna subdivision.

4.2 HYDRAULIC MODELS

A total of two hydraulic models were examined for this project site – the existing conditions based on existing topography and the revised conditions based on the proposed construction for the site. These models and the information on which they are based is presented below.

4.2.1 BASIS OF HORITZONTAL AND VERTICAL DATUMS

The project site is located within the City of Scottsdale, AZ and is located on the NAVD 88 vertical datum. More specifically, a 3" City of Scottsdale Brass Cap flush marking the north ¼ corner of section 21, T 3N, R 5E at the intersection of 108th Street and Cactus Road with a NAVD88 Elevation of 1458.39 was utilized. Horizontally, the site is located on the NAD83 State Plane Coordinate System for Central Arizona. This is the same horizontal datum that has been utilized by the previous flood study for this area.

4.2.2 TOPOGRAPHIC WORK MAP

The project site topography for the existing conditions was generated by a field survey utilizing GPS equipment and the above basis of bearings. The topography was generated with 1-foot contours and an accuracy of ± 0.10-feet.

4.2.3 HEC-RAS MODELING

Modeling of both the existing and proposed conditions models was done utilizing HEC-RAS software version 5.0.6 on Windows operating system 10 professional. Data input to the HEC-RAS program was accomplished by importing geo-referenced cross-section and thalweg information that was generated from AutoCAD Civil 3d 2018 surface models of the existing and proposed conditions of the site. Additionally, geo-referenced shape files of the existing and revised conditions generated by Civil 3d were inputted to HEC-RAS so that the exact limits of inundation could be determined.

HEC-RAS modeling utilized the above referenced sections and thalweg information and the flow determined in Section 3.1 above. A manning's roughness of 0.030 was utilized for both models. After the models run, the inundation limits of the models were generated utilizing the shape files from Civil 3d along with the HEC-Mapper program within HEC-RAS. The generated inundation limits were then export out and into the respective existing and proposed conditions civil 3d work maps. A copy of the existing and proposed conditions work maps are attached along with reports of both models. A summary of both models are provided in Table 4.1 below comparing the water surface between the pre- and post-development conditions.

RIVER STATION	**WATER SURFACE ELEVATION** (ft)		
	Pre-Development	Post-Development	Difference
14+69.95	1432.61	1431.71	-1.00
14+18.20	1430.87	1430.36	-0.51
13+43.59	1428.79	1427.39	-1.40
12+90.88	1427.28	1426.66	-0.62
11+84.70	1424.87	1424.41	-0.46
11+40.58	1424.53	1424.03	-0.50
10+79.35	1423.86	1423.15	-0.71

Table 4.1 – 100-Year Water Surface Elevations

5.0 RETENTION

The required retention volume for each lot is calculated using the following formula:

$$V = \frac{D}{12} A C$$

Where:

V_r = Require Retention Volume (ac-ft)
C = Runoff Coefficient (0.61 per DSPM Chapter 4, R1-43 Zoning)
D = 100-year, 2-hour rainfall depth (2.3-in/hr per County Manual)
A = Drainage Area (ac)

Tables 5.1 and 5.2 summarize the retention volumes required and provided for each of the two lots apart of the project.

Drainage Area	**Land Use**	**Area** (ft2)	**i** (inches)	**"C"**	**Volume Required** (ft^3)
Lot 1	R1-43	45,934	2.3	0.61	5,371
Lot 2	R1-43	45,693	2.3	0.61	5,342
	TOTAL	**91,627**			**10,713**

Table 5.1 – Retention Volume Required

Retention for each lot will be provided on the south side of each lot within a designated drainage easement. Each basin will be 0.5-feet in depth with 4:1 side slopes on all sides. Per the DSPM, percolation tests are not required on basins 6-inches in depth or less. Table 5.2 below summarizes the retention volume provided for each lot.

Drainage Area	**Basin**	**Average Area** (ft)	**Average Depth** (ft)	**Volume Provided** (ft^3)	**Volume Required** (ft^3)
Lot 1	A	1,575.0	0.5	787.5	
	B	9,236.0	0.5	4,618	
			Sub-Total	5,405.5	5,251
.Lot 2	A	2,421.0	0.5	1,210.5	
	B	9,123.0	0.5	4,561.5	
			Sub-Total	5,772.0	5,342
			TOTAL	**11,177.5**	**10,713**

Table 5.1 – Retention Volume Provided

6.0 REFERENCES

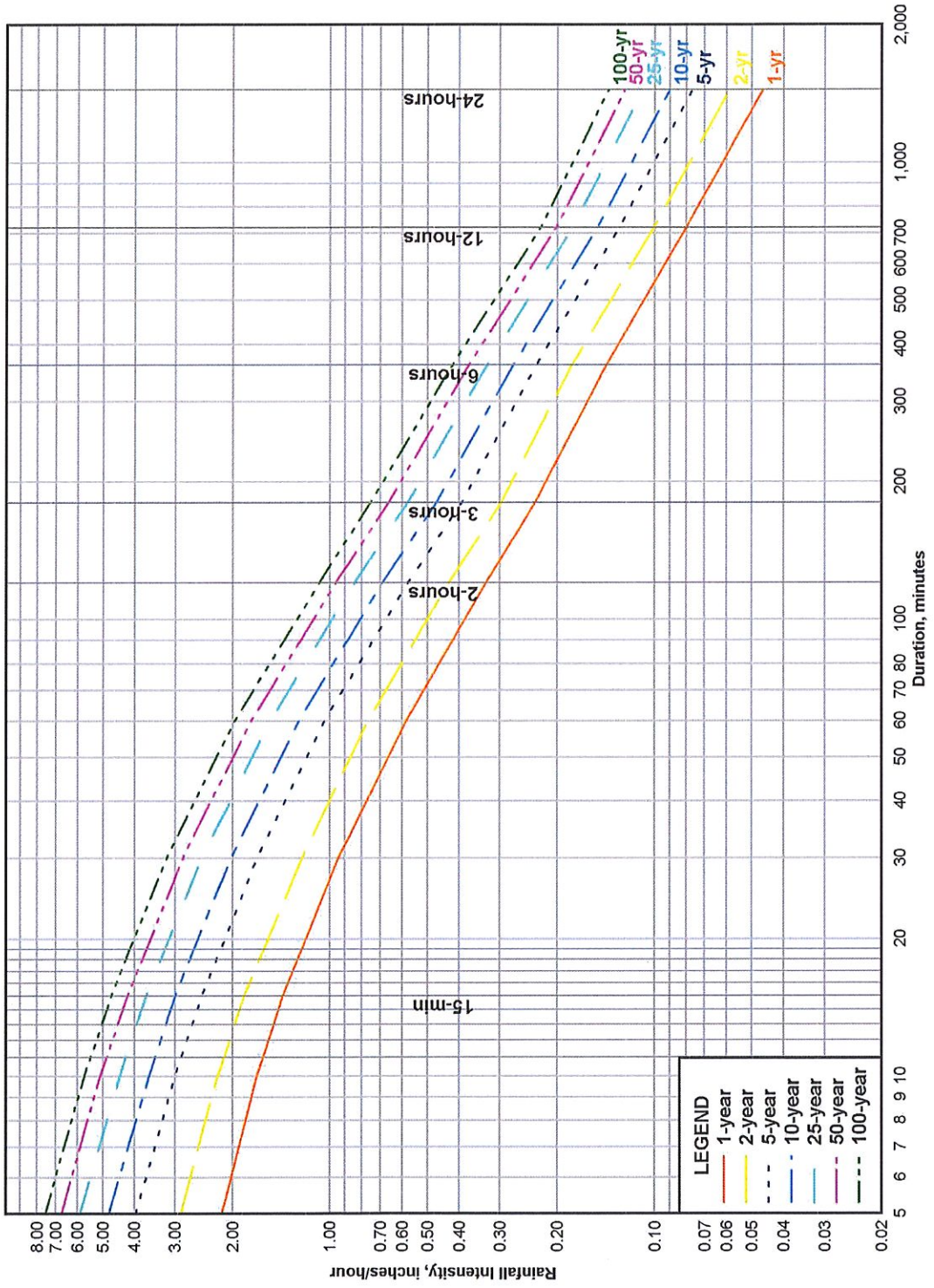
City of Scottsdale, Design Standards & Principals Manual – Chapter 4, 2018

Flood Control District of Maricopa County, Pinnacle Peak West ADMS Fans 5 and 6 Redelineation Study, January 2018.

Arizona Department of Water Resources, State Standard for Watercourse System Sediment Balance (ADWR 5-96), September 1996.

APPENDIX

Figure B.2
NOAA ATLAS 14 I-D-F CURVES AT PHOENIX-SKY HARBOR



The Rational Equation is based on the concept that the application of a steady, uniform rainfall intensity will produce a peak discharge at such a time when all points of the watershed are contributing to the outflow at the point of design. Such a condition is met when the elapsed time is equal to the time of concentration, T_c, which is defined to be the floodwave travel time from the most remote part of the watershed to the point of design. The time of concentration should be computed by applying the following equation developed by Papadakis and Kazan (1987):

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38} \qquad (3.2)$$

where:

T_c = time of concentration, in hours.

L = length of the longest flow path, in miles.

K_b = watershed resistance coefficient (see Table 3.1 or Figure 3.1).

S = watercourse slope, in feet/mile.

i = rainfall intensity, in inches/hour.*

*It should be noted that i is the "rainfall excess intensity" as originally developed. However, when used in the Rational Equation, rainfall intensity and rainfall excess intensity provide similar values because the hydrologic characteristics of small, urban watersheds result in minimal rainfall loss. This is due to the extent of imperviousness associated with urban watersheds and to the fact that the time of concentration is usually very short.

Rational Method runoff coefficients for land uses are provided in Table 3.2.

Table 3.2
RUNOFF COEFFICIENTS FOR MARICOPA COUNTY

Land Use Code	Land Use Category	Runoff Coefficients by Storm Frequency[1, 2]							
		2-10 Year		25 Year		50 Year		100 Year	
		min	max	min	max	min	max	min	max
VLDR	Very Low Density Residential[3, 4]	0.33	0.42	0.36	0.46	0.40	0.50	0.41	0.53
LDR	Low Density Residential[3, 4]	0.42	0.48	0.46	0.53	0.50	0.58	0.53	0.60
MDR	Medium Density Residential[3, 4]	0.48	0.65	0.53	0.72	0.58	0.78	0.60	0.82
MFR	Multiple Family Residential[3, 4]	0.65	0.75	0.72	0.83	0.78	0.90	0.82	0.94
I1	Industrial 1[3]	0.60	0.70	0.66	0.77	0.72	0.84	0.75	0.88
I2	Industrial 2[3]	0.70	0.80	0.77	0.88	0.84	0.95	0.88	0.95
C1	Commercial 1[3]	0.55	0.65	0.61	0.72	0.66	0.78	0.69	0.81
C2	Commercial 2[3]	0.75	0.85	0.83	0.94	0.90	0.95	0.94	0.95
P	Pavement and Rooftops	0.75	0.85	0.83	0.94	0.90	0.95	0.94	0.95
GR	Gravel Roadways & Shoulders	0.60	0.70	0.66	0.77	0.72	0.84	0.75	0.88
AG	Agricultural	0.10	0.20	0.11	0.22	0.12	0.24	0.13	0.25
LPC1	Lawns/Parks/Cemeteries (s<5)	0.10	0.25	0.11	0.28	0.12	0.30	0.13	0.31
LPC2	Lawns/Parks/Cemeteries (s>5)	0.25	0.40	0.28	0.44	0.30	0.48	0.31	0.50
DL1	Desert Landscaping 1	0.55	0.85	0.61	0.94	0.66	0.95	0.69	0.95
DL2	Desert Landscaping 2	0.30	0.40	0.33	0.44	0.36	0.48	0.38	0.50
NDR	Undeveloped Desert Rangeland	0.30	0.40	0.33	0.44	0.36	0.48	0.38	0.50
NHS	Hillslopes, Sonoran Desert	0.40	0.55	0.44	0.61	0.48	0.66	0.50	0.69
NMT	Mountain Terrain	0.55	0.80	0.61	0.88	0.66	0.95	0.69	0.95

Notes:

1. Runoff coefficients for 25-, 50- and 100-Year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 Year values with an upper limit of 0.95.

2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.

3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of-way, or alleys.

4, Values are based on the NDR terrain class. Values should be increased for NHS and NMT terrain classes by the difference between NHS (or NMT) and the NDR C values, up to a maximum of 0.95. Engineering judgement should be used.

5. Maricopa County has adopted specific values of C for each land use and storm frequency in the Drainage Policies and Standards for Maricopa County, Arizona (Maricopa County, 2007). These are the standard default values. The engineer/hydrologist may develop a computed composite value of C based on actual land uses, but must fully document the computations and assumptions and submit them to Maricopa County for approval. Many jurisdictions in Maricopa County may have adopted specific C coefficient values and procedures. The user should check with the appropriate agency before proceeding.

FIGURE A.56
100-YEAR 2-HOUR RAINFALL ISOPLUVIALS

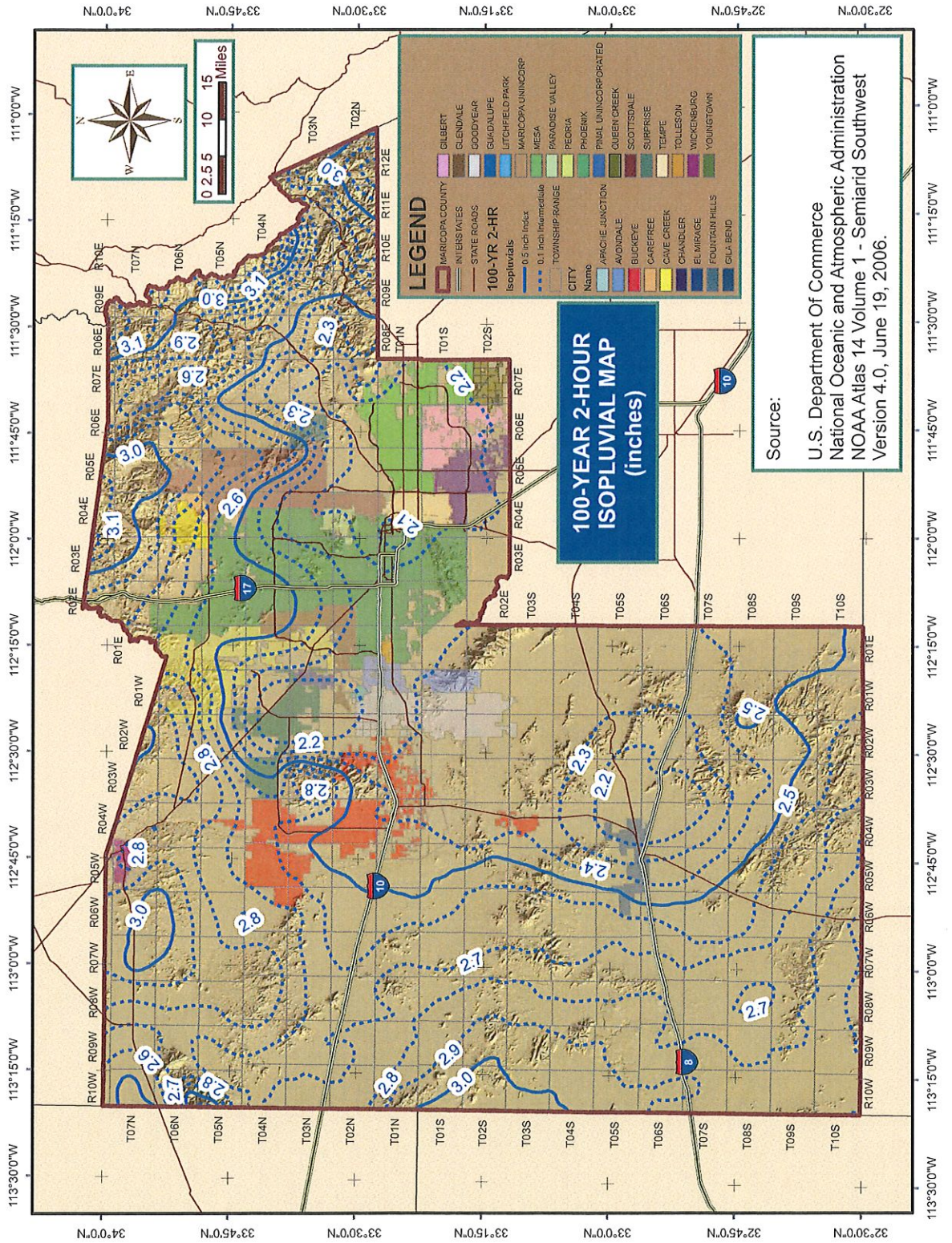
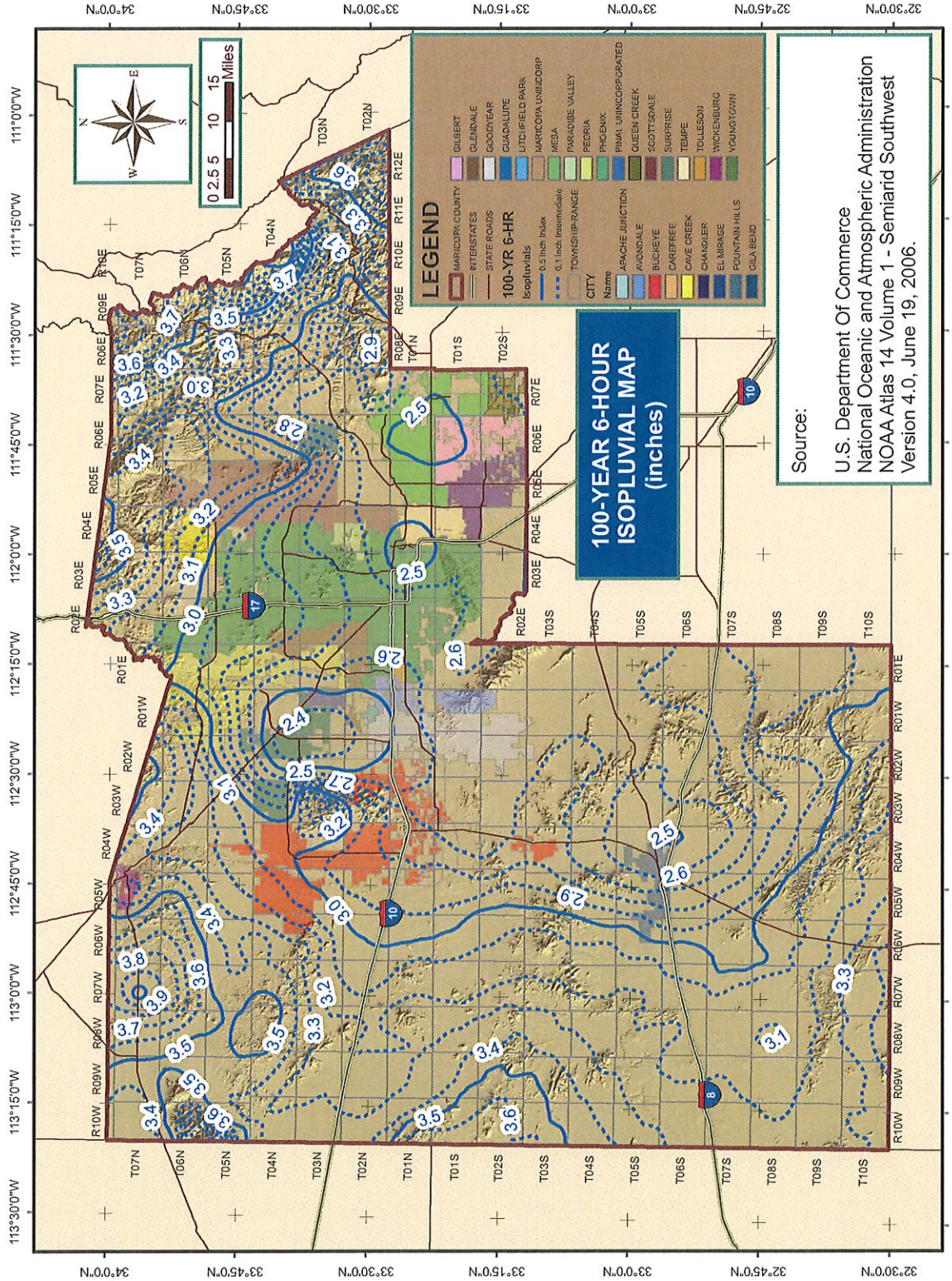


FIGURE A.58
100-YEAR 6-HOUR RAINFALL ISOPLUVIALS



2.4.2 6-hour Storm Distribution

The 6-hour storm distributions are used for flood studies and design of stormwater drainage facilities in Maricopa County of drainage areas less than 20 square miles, except for on-site stormwater storage facilities (see *Policies and Standards Manual*). These distributions would also be used for drainage areas larger than 20 square miles and smaller than 100 square miles by critically centering the storm over all or portions of the drainage area to estimate the peak flood discharges that could be realized on such watersheds due to the occurrence of a local storm over the watershed.

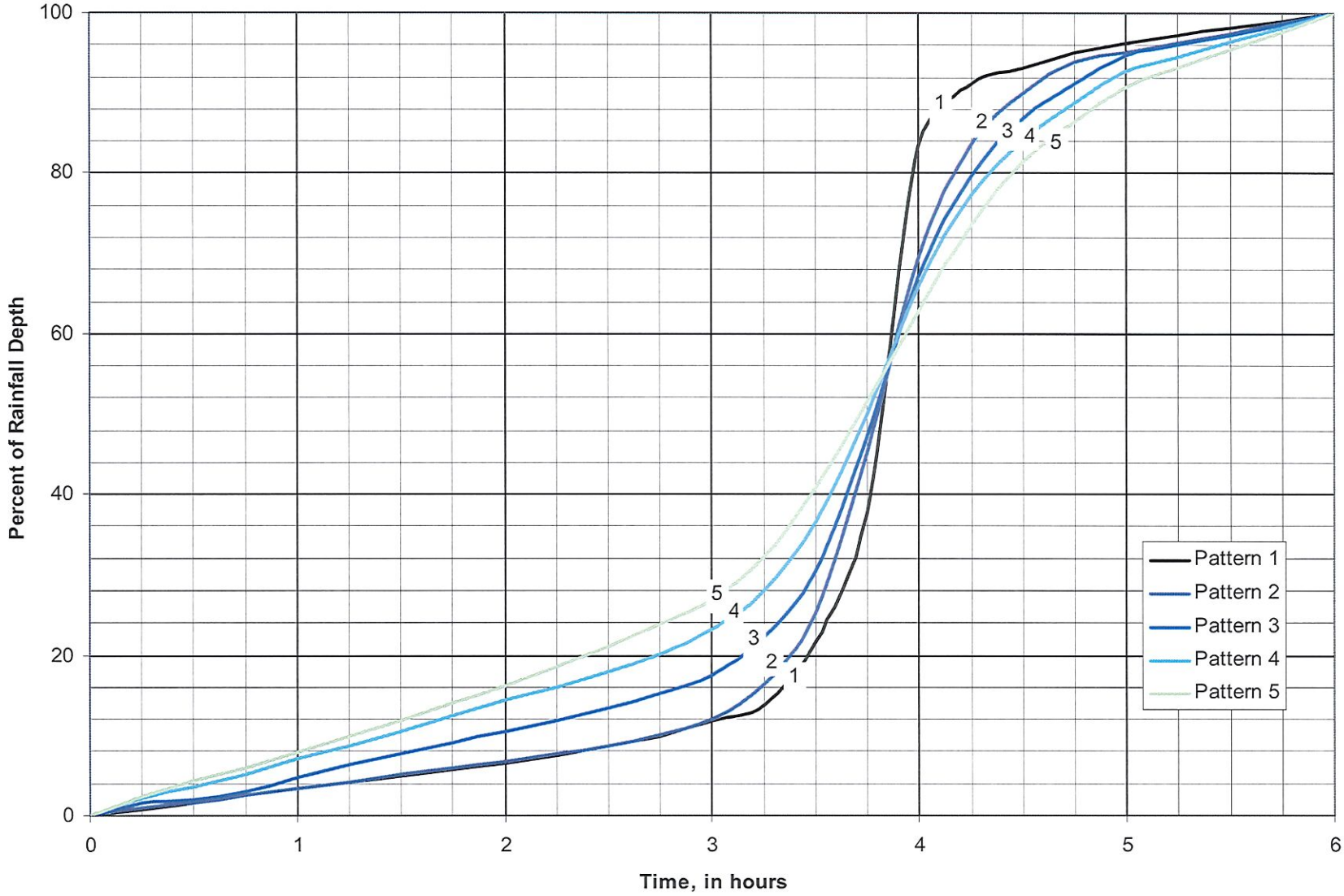
The Maricopa County 6-hour local storm distributions consist of five dimensionless storm patterns. Pattern No. 1 represents the rainfall intensities that can be expected in the "eye" of a local storm. These high, short-duration rainfall intensities would only occur over a relatively small area near the center of the storm cell. Pattern No. 1 is an offset, dimensionless form of the hypothetical distribution derived from rainfall statistics found in the NOAA Atlas for the Western United States, Arizona (Miller et al. 1973) and Arkell and Richards (1986) for the Phoenix Sky Harbor Airport location. Pattern Numbers 2 through 5 are modifications of the U.S. Army Corps of Engineers (1974) analysis of the Queen Creek storm of 19 August 1954. The dimensionless form of these 6-hour storm distributions are shown in and Table 2.4.

Inspection of the storm patterns indicates that the peak rainfall intensities are much greater for Pattern No. 1 than for the other pattern numbers, and that peak rainfall intensity decreases as the pattern number increases. The selection of the pattern number is based on the size of the drainage area under consideration, as shown in Figure 2.5. As illustrated by Figure 2.5, the maximum rainfall intensities, averaged over the entire drainage area, decrease as the size of the drainage area increases. This is to account for the spatial variability of local storm rainfall wherein the maximum rainfall intensities occur at the relatively small eye of the storm but that the average rainfall intensities over the storm area decrease as the storm area increases.

Table 2.4
6-HOUR DISTRIBUTIONS

Time, in hours	Percent of Rainfall Depth				
	Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5
0.00	0.0	0.0	0.0	0.0	0.0
0.25	0.8	0.9	1.5	2.1	2.4
0.50	1.6	1.6	2.0	3.5	4.3
0.75	2.5	2.5	3.0	5.1	5.9
1.00	3.3	3.4	4.8	7.1	7.8
1.25	4.1	4.2	6.3	8.7	9.8
1.50	5.0	5.1	7.6	10.5	11.9
1.75	5.8	5.9	9.0	12.5	14.1
2.00	6.6	6.7	10.5	14.3	16.2
2.25	7.4	7.6	11.9	16.0	18.6
2.50	8.7	8.7	13.5	17.9	21.2
2.75	9.9	10.0	15.2	20.1	23.9
3.00	11.8	12.0	17.5	23.2	27.1
3.25	13.8	16.3	22.2	28.1	32.1
3.50	21.6	25.2	30.4	36.4	40.8
3.75	37.7	45.1	47.2	50.0	51.5
4.00	83.4	69.4	67.0	65.8	62.7
4.25	91.1	83.7	79.6	77.3	73.5
4.50	93.1	90.0	86.8	84.1	81.4
4.75	95.0	93.8	91.2	88.8	86.4
5.00	96.2	95.0	94.6	92.7	90.7
5.25	97.2	96.3	96.0	94.5	93.0
5.50	98.3	97.5	97.3	96.4	95.4
5.75	99.1	98.8	98.7	98.2	97.7
6.00	100.0	100.0	100.0	100.0	100.0

Figure 2.4
6-HOUR MASS CURVES FOR MARICOPA COUNTY



RATIONAL CALCULATIONS (190908)

Q=CiA

Tc = 11.4LKb^0.52S^-0.31i^-0.38

POINT OF CONC.	C	A (ac)	i (in/hr)	L (mi)	Kb	S (ft/mi)	Tc (min)	Q (cfs)
A	0.6	28.67	6.38	0.45	0.060	143	7.5	109.7
B	0.6	14.10	6.38	0.45	0.064	164	7.5	53.9
C	0.6	4.40	7.60	0.17	0.071	164	5.0	20.1

PRE-DEVELOPMENT RATIONAL CALCULATIONS (190908)

Q=CiA

Tc = 11.4LKb^0.52S^-0.31i^-0.38

POINT OF CONC.	C	A (AC)	i	L (miles)	Kb	S (ft/mile)	Tc (min)	Q (cfs)
OUTFALL	0.5	2.50	7.60	0.07	0.075	175	5.0	9.5

Post Development Peak Runoff

Rainfall Amount =	2.80	inches
Total Area =	2.50	acres
C =	0.60	
Site Ret'n Volume =	11,364.3	cf

Time (Hours)	Rainfall Depth (%)	Rainfall Amount (inches)	Rainfall Intensity (in/hr)	Runoff Volume (ft^3)	Cummulative Runoff Volume (ft^3)		
0.00	0.00%	0.00	0.00	0.00	0.00		
0.25	0.80%	0.02	0.09	121.97	121.97		
0.50	1.60%	0.04	0.09	121.97	243.94		
0.75	2.50%	0.07	0.10	137.21	381.15		
1.00	3.30%	0.09	0.09	121.97	503.12		
1.25	4.10%	0.11	0.09	121.97	625.09		
1.50	5.00%	0.14	0.10	137.21	762.30		
1.75	5.80%	0.16	0.09	121.97	884.27		
2.00	6.60%	0.18	0.09	121.97	1,006.24		
2.25	7.40%	0.21	0.09	121.97	1,128.20		
2.50	8.70%	0.24	0.15	198.20	1,326.40		
2.75	9.90%	0.28	0.13	182.95	1,509.35		
3.00	11.80%	0.33	0.21	289.67	1,799.03		
3.25	13.80%	0.39	0.22	304.92	2,103.95		
3.50	21.60%	0.60	0.87	1,189.19	3,293.14		
3.75	37.70%	1.06	1.80	2,454.61	5,747.74		
3.92	**75.00%**	**2.10**	**6.13**	**5,686.76**	**11,434.50**	**11,364.30**	**74.54%**
4.00	83.40%	2.34	**2.96**	1,280.66	12,715.16		
4.25	91.10%	2.55	0.86	1,173.94	13,889.11		
4.50	93.10%	2.61	0.22	304.92	14,194.03		
4.75	95.00%	2.66	0.21	289.67	14,483.70		
5.00	96.20%	2.69	0.13	182.95	14,666.65		
5.25	97.20%	2.72	0.11	152.46	14,819.11		
5.50	98.30%	2.75	0.12	167.71	14,986.82		
5.75	99.10%	2.77	0.09	121.97	15,108.79		
6.00	100.00%	2.80	0.10	137.21	15,246.00		

Peak Flow = 2.5 x 0.60 x2.96 = 4.44

HEC-RAS HEC-RAS 5.0.6 November 2018
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: EXISTING
Project File : EXISTING.prj
Run Date and Time: 5/5/2020 10:54:15 AM

Project in English units

PLAN DATA

Plan Title: Plan 02
Plan File : k:\TWeber\190908\EXISTING.p02

Geometry Title: EXISTING_UPDATE
Geometry File : k:\TWeber\190908\EXISTING.g02

Flow Title : EXISTING
Flow File : k:\TWeber\190908\EXISTING.f01

Plan Summary Information:

Number of:	Cross Sections	= 7	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: EXISTING
Flow File : k:\TWeber\190908\EXISTING.f01

Flow Data (cfs)

River	Reach	RS	PF 1
THALWAG	THALWAG	1469.95	54
THALWAG	THALWAG	1184.7	54
THALWAG	THALWAG	1140.58	163.7

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
THALWAG	THALWAG	PF 1	Normal S = 0.03	Normal S = 0.03

GEOMETRY DATA

Geometry Title: EXISTING_UPDATE
Geometry File : k:\TWeber\190908\EXISTING.g02

CROSS SECTION

RIVER: THALWAG
REACH: THALWAG RS: 1469.95

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1433.11	20.03	1433.02	23.3	1433.05	24.43	1433	25.47	1433
26.97	1432.93	40.28	1432.68	42.4	1432.62	43	1432.48	46.59	1431.4
47.88	1431.01	48.86	1431.29	55.4	1433.13				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0		0	.035	55.4	.035

Bank Sta: Left	Right	Lengths: Left Channel		Right	Coeff Contr.	Expan.
0	55.4	51.75	51.75	51.75	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1433.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.58	Wt. n-Val.			0.035
W.S. Elev (ft)	1432.61	Reach Len. (ft)	51.75	51.75	51.75
Crit W.S. (ft)	1432.85	Flow Area (sq ft)			8.81

E.G. Slope (ft/ft)	0.030002	Area (sq ft)	8.81
Q Total (cfs)	54.00	Flow (cfs)	54.00
Top Width (ft)	11.13	Top Width (ft)	11.13
Vel Total (ft/s)	6.13	Avg. Vel. (ft/s)	6.13
Max Chl Dpth (ft)	1.60	Hydr. Depth (ft)	0.79
Conv. Total (cfs)	311.8	Conv. (cfs)	311.8
Length Wtd. (ft)	51.75	Wetted Per. (ft)	11.58
Min Ch El (ft)	1431.01	Shear (lb/sq ft)	1.42
Alpha	1.00	Stream Power (lb/ft s)	8.73
Frctn Loss (ft)	1.77	Cum Volume (acre-ft)	0.23
0.05			
C & E Loss (ft)	0.01	Cum SA (acres)	0.28
0.08			

CROSS SECTION

RIVER: THALWAG
REACH: THALWAG RS: 1418.2

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1432.63	.9	1432.62	2.7	1432.6	6.51	1432.56	30.85	1431.52
38.35	1431.27	48.01	1430.72	49.37	1430.68	53.89	1429.57	54.32	1429.47
54.72	1429.35	62.59	1431.56	62.99	1431.67	64.43	1431.65		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0		0	.035	64.43	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	64.43	51.75	51.75	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1431.42	Element	Left OB		
Channel Right OB					
Vel Head (ft)	0.56	Wt. n-Val.			0.035
W.S. Elev (ft)	1430.87	Reach Len. (ft)	51.75		51.75
51.75					
Crit W.S. (ft)	1431.03	Flow Area (sq ft)			9.02
E.G. Slope (ft/ft)	0.039334	Area (sq ft)			9.02
Q Total (cfs)	54.00	Flow (cfs)			54.00
Top Width (ft)	14.69	Top Width (ft)			14.69
Vel Total (ft/s)	5.98	Avg. Vel. (ft/s)			5.98
Max Chl Dpth (ft)	1.52	Hydr. Depth (ft)			0.61
Conv. Total (cfs)	272.3	Conv. (cfs)			272.3
Length Wtd. (ft)	51.75	Wetted Per. (ft)			15.06
Min Ch El (ft)	1429.35	Shear (lb/sq ft)			1.47
Alpha	1.00	Stream Power (lb/ft s)			8.80
Frctn Loss (ft)	2.11	Cum Volume (acre-ft)			0.22
0.05					
C & E Loss (ft)	0.01	Cum SA (acres)			0.26
0.08					

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.

CROSS SECTION

RIVER: THALWAG
REACH: THALWAG RS: 1343.59

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1431.14	11.37	1431.25	23.21	1430.37	25.6	1430.46	29.62	1429.01
29.67	1429	34.86	1428.78	38.02	1428.61	41.14	1428.27	43.73	1427.81
45.53	1427.49	51.15	1428.67	54.03	1429.14				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0		0	.035	54.03	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	54.03	74.61	74.61	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1429.31	Element	Left OB	Channel Right OB
Vel Head (ft)	0.52	Wt. n-Val.		0.035
W.S. Elev (ft)	1428.79	Reach Len. (ft)	74.61	74.61 74.61
Crit W.S. (ft)	1428.95	Flow Area (sq ft)		9.34
E.G. Slope (ft/ft)	0.042357	Area (sq ft)		9.34
Q Total (cfs)	54.00	Flow (cfs)		54.00
Top Width (ft)	17.11	Top Width (ft)		17.11
Vel Total (ft/s)	5.78	Avg. Vel. (ft/s)		5.78
Max Chl Dpth (ft)	1.30	Hydr. Depth (ft)		0.55
Conv. Total (cfs)	262.4	Conv. (cfs)		262.4
Length Wtd. (ft)	74.61	Wetted Per. (ft)		17.34
Min Ch El (ft)	1427.49	Shear (lb/sq ft)		1.42
Alpha	1.00	Stream Power (lb/ft s)		8.24
Frctn Loss (ft)	1.65	Cum Volume (acre-ft)		0.21 0.05
C & E Loss (ft)	0.00	Cum SA (acres)		0.25 0.08

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.

CROSS SECTION

RIVER: THALWAG
REACH: THALWAG RS: 1290.88

INPUT

Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1430.36	3.03	1430.42	22.65	1430.12	24.72	1429.62	27.65	1427.82
27.89	1427.64	28.33	1427.33	33.33	1427.03	33.58	1427.12	33.9	1427.04
34.01	1426.99	34.4	1426.99	41.82	1426.17	43.02	1426.04	43.38	1426.03
51.27	1427.34	51.56	1427.35						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0		0	.035	51.27	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	51.27	52.71	52.71	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1427.57	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.035	
W.S. Elev (ft)	1427.28	Reach Len. (ft)	52.71	52.71	52.71
Crit W.S. (ft)	1427.28	Flow Area (sq ft)		12.44	
E.G. Slope (ft/ft)	0.022131	Area (sq ft)		12.44	
Q Total (cfs)	54.00	Flow (cfs)		54.00	
Top Width (ft)	21.65	Top Width (ft)		21.65	
Vel Total (ft/s)	4.34	Avg. Vel. (ft/s)		4.34	
Max Chl Dpth (ft)	1.25	Hydr. Depth (ft)		0.57	
Conv. Total (cfs)	363.0	Conv. (cfs)		363.0	
Length Wtd. (ft)	52.71	Wetted Per. (ft)		21.85	
Min Ch El (ft)	1426.03	Shear (lb/sq ft)		0.79	
Alpha	1.00	Stream Power (lb/ft s)		3.41	
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)		0.19	0.05
C & E Loss (ft)	0.08	Cum SA (acres)		0.21	0.08

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: THALWAG
REACH: THALWAG RS: 1184.7

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1427.41	.03	1427.41	7	1427	18.7	1427	21.28	1426.8
34.02	1424.02	41.29	1423.59	43.96	1423.61	53.74	1423.72	59.95	1423.96
69.85	1423.95	79.63	1424.51	83.86	1424.33	100.33	1424.14	111.55	1423.96

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0		0	.035	79.63	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	79.63	106.18	106.18	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1424.88	Element	Left OB	Channel Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.035	0.035
W.S. Elev (ft)	1424.87	Reach Len. (ft)	106.18	106.18 106.18
Crit W.S. (ft)	1424.21	Flow Area (sq ft)	46.30	21.57
E.G. Slope (ft/ft)	0.000442	Area (sq ft)	46.30	21.57
Q Total (cfs)	54.00	Flow (cfs)	39.45	14.55
Top Width (ft)	81.43	Top Width (ft)	49.51	31.92
Vel Total (ft/s)	0.80	Avg. Vel. (ft/s)	0.85	0.67
Max Chl Dpth (ft)	1.28	Hydr. Depth (ft)	0.94	0.68
Conv. Total (cfs)	2568.7	Conv. (cfs)	1876.7	692.0
Length Wtd. (ft)	106.18	Wetted Per. (ft)	49.63	32.84
Min Ch El (ft)	1423.59	Shear (lb/sq ft)	0.03	0.02
Alpha	1.03	Stream Power (lb/ft s)	0.02	0.01
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)	0.16	0.04
C & E Loss (ft)	0.01	Cum SA (acres)	0.17	0.06

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Note: Hydraulic jump has occurred between this cross section and the previous upstream section.

CROSS SECTION

RIVER: THALWAG
REACH: THALWAG RS: 1140.58

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1427.07	3.52	1427	14.56	1427	28.76	1425.34	35.47	1423.94
44.44	1423.62	46.36	1423.52	58.78	1422.84	61.16	1422.97	78.9	1424.01
81.57	1424.08	94.88	1423.87						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0		0	.035	81.57	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	81.57	44.12	44.12	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1424.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.	0.035	0.035	
W.S. Elev (ft)	1424.53	Reach Len. (ft)	44.12	44.12	44.12
Crit W.S. (ft)		Flow Area (sq ft)	49.63	7.35	
E.G. Slope (ft/ft)	0.004948	Area (sq ft)	49.63	7.35	
Q Total (cfs)	163.70	Flow (cfs)	149.41	14.29	
Top Width (ft)	62.22	Top Width (ft)	48.91	13.31	
Vel Total (ft/s)	2.87	Avg. Vel. (ft/s)	3.01	1.95	
Max Chl Dpth (ft)	1.69	Hydr. Depth (ft)	1.01	0.55	
Conv. Total (cfs)	2327.3	Conv. (cfs)	2124.1	203.2	
Length Wtd. (ft)	44.12	Wetted Per. (ft)	49.04	13.97	
Min Ch El (ft)	1422.84	Shear (lb/sq ft)	0.31	0.16	
Alpha	1.04	Stream Power (lb/ft s)	0.94	0.32	
Frctn Loss (ft)	0.40	Cum Volume (acre-ft)	0.04	0.00	
C & E Loss (ft)	0.02	Cum SA (acres)	0.05	0.01	

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: THALWAG
REACH: THALWAG RS: 1079.35

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1425.59	9.01	1424.8	16.06	1424.19	18.27	1424.04	32.28	1423.46
45.27	1423.6	50.26	1423.7	57.79	1422.07	60.21	1421.55	63.09	1422.02
65.75	1422.46	68.51	1423.2	71.22	1424.23	78.72	1424.72	89.64	1424.67
96.21	1424.49	101.69	1424.4						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0		0	.035	78.72	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	78.72	61.23	61.23	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1424.24	Element	Left OB
Channel	Right OB		
Vel Head (ft)	0.37	Wt. n-Val.	0.035
W.S. Elev (ft)	1423.86	Reach Len. (ft)	
Crit W.S. (ft)	1423.86	Flow Area (sq ft)	33.37
E.G. Slope (ft/ft)	0.021809	Area (sq ft)	33.37
Q Total (cfs)	163.70	Flow (cfs)	163.70
Top Width (ft)	47.68	Top Width (ft)	47.68
Vel Total (ft/s)	4.91	Avg. Vel. (ft/s)	4.91
Max Chl Dpth (ft)	2.31	Hydr. Depth (ft)	0.70
Conv. Total (cfs)	1108.5	Conv. (cfs)	1108.5
Length Wtd. (ft)		Wetted Per. (ft)	48.22
Min Ch El (ft)	1421.55	Shear (lb/sq ft)	0.94
Alpha	1.00	Stream Power (lb/ft s)	4.62
Frctn Loss (ft)		Cum Volume (acre-ft)	
C & E Loss (ft)		Cum SA (acres)	

Warning: Slope too steep for slope area to converge during supercritical flow calculations (normal depth is below critical
depth). Water surface set to critical depth.

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
THALWAG	1469.95	PF 1	54.00	1431.01	1432.61	1432.85	1433.20	0.030002	6.13	8.81	11.13	1.21
THALWAG	1418.2	PF 1	54.00	1429.35	1430.87	1431.03	1431.42	0.039334	5.98	9.02	14.69	1.35
THALWAG	1343.59	PF 1	54.00	1427.49	1428.79	1428.95	1429.31	0.042357	5.78	9.34	17.11	1.38

THALWAG	1290.88	PF 1	54.00	1426.03	1427.28	1427.28	1427.57	0.022131	4.34	12.44	21.65	1.01
THALWAG	1184.7	PF 1	54.00	1423.59	1424.87	1424.21	1424.88	0.000442	0.85	67.87	81.43	0.16
THALWAG	1140.58	PF 1	163.70	1422.84	1424.53	1424.66	0.004948	3.01	56.98	62.22	0.53	
THALWAG	1079.35	PF 1	163.70	1421.55	1423.86	1423.86	1424.24	0.021809	4.91	33.37	47.68	1.03

ERRORS WARNINGS AND NOTES
Errors Warnings and Notes for Plan : Plan 02

River: THALWAG Reach: THALWAG RS: 1418.2 Profile: PF 1
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.
River: THALWAG Reach: THALWAG RS: 1343.59 Profile: PF 1
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.
River: THALWAG Reach: THALWAG RS: 1290.88 Profile: PF 1
Warning:The energy equation could not be balanced within the specified number of iterations. The program used critical depth
for the water surface and continued on with the calculations.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.
Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
program defaulted to critical depth.
River: THALWAG Reach: THALWAG RS: 1184.7 Profile: PF 1
Warning:The cross-section end points had to be extended vertically for the computed water surface.
Note: Hydraulic jump has occurred between this cross section and the previous upstream section.
River: THALWAG Reach: THALWAG RS: 1140.58 Profile: PF 1
Warning:The cross-section end points had to be extended vertically for the computed water surface.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
River: THALWAG Reach: THALWAG RS: 1079.35 Profile: PF 1
Warning:Slope too steep for slope area to converge during supercritical flow calculations (normal depth is below critical
depth). Water surface set to critical depth.

HEC-RAS HEC-RAS 5.0.6 November 2018
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: PROP_8-12-20
Project File : PROP_8-12-20.prj
Run Date and Time: 9/9/2020 10:55:06 AM

Project in English units

PLAN DATA

Plan Title: Plan 02
Plan File : k:\TWeber\190908\PROP_8-12-20.p02

Geometry Title: Geom 01
Geometry File : k:\TWeber\190908\PROP_8-12-20.g01

Flow Title : Flow 01
Flow File : k:\TWeber\190908\PROP_8-12-20.f01

Plan Summary Information:
Number of: Cross Sections = 7 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Flow 01
Flow File : k:\TWeber\190908\PROP_8-12-20.f01

Flow Data (cfs)

River	Reach	RS	PF 1
FINISHED SURFACE	THALWAG 8-12-20	1469.95	54
FINISHED SURFACE	THALWAG 8-12-20	1140.78	163.7

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
FINISHED SURFACE	THALWAG 8-12-20	PF 1	Normal S = 0.023	Normal S = 0.023

GEOMETRY DATA

Geometry Title: Geom 01
Geometry File : k:\TWeber\190908\PROP_8-12-20.g01

CROSS SECTION

RIVER: FINISHED SURFACE
REACH: THALWAG 8-12-20 RS: 1469.95

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1432	1.34	1432	2.05	1431.57	3.47	1431	5.04	1430.48
5.57	1430.47	5.68	1430.47	11.82	1431.06	12.37	1431.08	12.64	1431.08
16.5	1431.5	111	1431.75						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	111	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	111	51.75	51.75	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1431.83	Element			
Vel Head (ft)	0.12	Wt. n-Val.		0.030	
W.S. Elev (ft)	1431.71	Reach Len. (ft)	51.75	51.75	51.75
Crit W.S. (ft)	1431.71	Flow Area (sq ft)		19.39	
E.G. Slope (ft/ft)	0.026313	Area (sq ft)		19.39	
Q Total (cfs)	54.00	Flow (cfs)		54.00	
Top Width (ft)	94.79	Top Width (ft)		94.79	
Vel Total (ft/s)	2.78	Avg. Vel. (ft/s)		2.78	
Max Chl Dpth (ft)	1.24	Hydr. Depth (ft)		0.20	
Conv. Total (cfs)	332.9	Conv. (cfs)		332.9	
Length Wtd. (ft)	51.75	Wetted Per. (ft)		95.07	
Min Ch El (ft)	1430.47	Shear (lb/sq ft)		0.34	
Alpha	1.00	Stream Power (lb/ft s)		0.93	
Frctn Loss (ft)	1.27	Cum Volume (acre-ft)		0.29	
C & E Loss (ft)	0.01	Cum SA (acres)		0.71	

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical
depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated

water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
program defaulted to critical depth.

CROSS SECTION

RIVER: FINISHED SURFACE
REACH: THALWAG 8-12-20 RS: 1418.2

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1431.14	.34	1431	1.13	1430.74	2.96	1430	6.07	1429.21
6.91	1429.19	7.48	1429.19	8.26	1429.21	14	1430.1	127	1430.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	127	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	127	74.61	74.61	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1430.46	Element			
Vel Head (ft)	0.10	Wt. n-Val.		0.030	
W.S. Elev (ft)	1430.36	Reach Len. (ft)	74.61	74.61	74.61
Crit W.S. (ft)	1430.36	Flow Area (sq ft)		21.27	
E.G. Slope (ft/ft)	0.022958	Area (sq ft)		21.27	
Q Total (cfs)	54.00	Flow (cfs)		54.00	
Top Width (ft)	107.91	Top Width (ft)		107.91	
Vel Total (ft/s)	2.54	Avg. Vel. (ft/s)		2.54	
Max Chl Dpth (ft)	1.16	Hydr. Depth (ft)		0.20	
Conv. Total (cfs)	356.4	Conv. (cfs)		356.4	
Length Wtd. (ft)	74.61	Wetted Per. (ft)		108.15	
Min Ch El (ft)	1429.19	Shear (lb/sq ft)		0.28	
Alpha	1.00	Stream Power (lb/ft s)		0.72	
Frctn Loss (ft)	1.02	Cum Volume (acre-ft)		0.26	
C & E Loss (ft)	0.00	Cum SA (acres)		0.59	

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical
depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
program defaulted to critical depth.

CROSS SECTION

RIVER: FINISHED SURFACE
REACH: THALWAG 8-12-20 RS: 1343.59

INPUT
Description:
Station Elevation Data num= 22

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  1428.9    3.33    1428    6.56 1427.17     7.4 1427.15    8.03 1427.15
   10.78 1427.36   11.87  1427.4   12.19 1427.41    14.5  1428.1   24.56 1428.35
   36.28  1428.1   51.38    1428   53.82 1428.07   54.12    1428   54.31 1427.95
   58.35    1427   59.45 1426.73   60.36  1426.5      74  1426.5   76.47    1427
     112    1428     130    1430

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03     130    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     130            52.71   52.71   52.71             .1       .3

CROSS SECTION OUTPUT  Profile #PF 1

  E.G. Elev (ft)           1427.52    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.13    Wt. n-Val.                          0.030
  W.S. Elev (ft)           1427.39    Reach Len. (ft)           52.71      52.71      52.71
  Crit W.S. (ft)                      Flow Area (sq ft)                    18.83
  E.G. Slope (ft/ft)      0.009058    Area (sq ft)                         18.83
  Q Total (cfs)              54.00    Flow (cfs)                           54.00
  Top Width (ft)             39.49    Top Width (ft)                       39.49
  Vel Total (ft/s)            2.87    Avg. Vel. (ft/s)                      2.87
  Max Chl Dpth (ft)           0.89    Hydr. Depth (ft)                      0.48
  Conv. Total (cfs)          567.4    Conv. (cfs)                          567.4
  Length Wtd. (ft)           52.71    Wetted Per. (ft)                     39.69
  Min Ch El (ft)           1426.50    Shear (lb/sq ft)                      0.27
  Alpha                       1.00    Stream Power (lb/ft s)                0.77
  Frctn Loss (ft)             0.73    Cum Volume (acre-ft)                  0.23
  C & E Loss (ft)             0.00    Cum SA (acres)                        0.46


Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or
greater than
         1.4.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: FINISHED SURFACE
REACH: THALWAG 8-12-20    RS: 1290.88

INPUT
Description:
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1427.15     .55    1427    2.35 1426.59    4.52    1426    6.32 1425.71
    7.96 1425.71      14  1426.7    24.5 1426.92      36  1426.7      43  1426.3
     130  1426.8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03     130    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     130           106.18  106.18  106.18             .1       .3

CROSS SECTION OUTPUT  Profile #PF 1

  E.G. Elev (ft)           1426.79    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.13    Wt. n-Val.                          0.030
  W.S. Elev (ft)           1426.66    Reach Len. (ft)          106.18     106.18     106.18
  Crit W.S. (ft)           1426.66    Flow Area (sq ft)                    18.54
  E.G. Slope (ft/ft)      0.024189    Area (sq ft)                         18.54
  Q Total (cfs)              54.00    Flow (cfs)                           54.00
```

Top Width (ft)	79.57	Top Width (ft)	79.57
Vel Total (ft/s)	2.91	Avg. Vel. (ft/s)	2.91
Max Chl Dpth (ft)	0.94	Hydr. Depth (ft)	0.23
Conv. Total (cfs)	347.2	Conv. (cfs)	347.2
Length Wtd. (ft)	106.18	Wetted Per. (ft)	79.77
Min Ch El (ft)	1425.71	Shear (lb/sq ft)	0.35
Alpha	1.00	Stream Power (lb/ft s)	1.02
Frctn Loss (ft)	0.18	Cum Volume (acre-ft)	0.21
C & E Loss (ft)	0.04	Cum SA (acres)	0.39

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical
depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
program defaulted to critical depth.

CROSS SECTION

RIVER: FINISHED SURFACE
REACH: THALWAG 8-12-20 RS: 1184.7

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1424.37	7	1423.6	14	1423.8	25	1424	36	1423.8
43.5	1423.2	52.59	1424	53.21	1423.85	54.59	1423.5	76.6	1423.5
77.99	1423.85	78.61	1424	85.56	1424	88.2	1424.66	89.81	1425
92.18	1425.59	94.29	1426	95.81	1426.38				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	95.81	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	95.81	43.92	43.92	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1424.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.030	
W.S. Elev (ft)	1424.41	Reach Len. (ft)	43.92	43.92	43.92
Crit W.S. (ft)		Flow Area (sq ft)		59.21	
E.G. Slope (ft/ft)	0.000571	Area (sq ft)		59.21	
Q Total (cfs)	54.00	Flow (cfs)		54.00	
Top Width (ft)	87.20	Top Width (ft)		87.20	
Vel Total (ft/s)	0.91	Avg. Vel. (ft/s)		0.91	
Max Chl Dpth (ft)	1.21	Hydr. Depth (ft)		0.68	
Conv. Total (cfs)	2259.9	Conv. (cfs)		2259.9	
Length Wtd. (ft)	43.92	Wetted Per. (ft)		87.52	
Min Ch El (ft)	1423.20	Shear (lb/sq ft)		0.02	
Alpha	1.00	Stream Power (lb/ft s)		0.02	
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.02	Cum SA (acres)		0.19	

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: FINISHED SURFACE
REACH: THALWAG 8-12-20 RS: 1140.78

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1423.94	1.05	1423.92	5.64	1423.86	6	1423.85	18.12	1423.37
27.59	1423	50.71	1423	55.26	1423.85	69.62	1423.85	69.62	1430

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	69.62	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	69.62	62.67	62.67	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1424.26	Element			
Vel Head (ft)	0.22	Wt. n-Val.		0.030	
W.S. Elev (ft)	1424.03	Reach Len. (ft)	62.67	62.67	62.67
Crit W.S. (ft)	1423.96	Flow Area (sq ft)		43.02	
E.G. Slope (ft/ft)	0.011290	Area (sq ft)		43.02	
Q Total (cfs)	163.70	Flow (cfs)		163.70	
Top Width (ft)	69.62	Top Width (ft)		69.62	
Vel Total (ft/s)	3.80	Avg. Vel. (ft/s)		3.80	
Max Chl Dpth (ft)	1.03	Hydr. Depth (ft)		0.62	
Conv. Total (cfs)	1540.6	Conv. (cfs)		1540.6	
Length Wtd. (ft)	62.67	Wetted Per. (ft)		69.99	
Min Ch El (ft)	1423.00	Shear (lb/sq ft)		0.43	
Alpha	1.00	Stream Power (lb/ft s)		1.65	
Frctn Loss (ft)	0.86	Cum Volume (acre-ft)		0.06	
C & E Loss (ft)	0.00	Cum SA (acres)		0.11	

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION

RIVER: FINISHED SURFACE
REACH: THALWAG 8-12-20 RS: 1078.11

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
19.03	1423.19	23.84	1423	32.31	1422.57	34.1	1422.53	39.64	1422.5
40.4	1422.49	51.17	1422.32	62.47	1422.16	63.09	1422.17	64.13	1422.17
76.93	1422.9	78.08	1422.96	101.69	1422.99	101.69	1430		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
19.03	.035	19.03	.03	101.69	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
19.03	101.69	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1423.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.25	Wt. n-Val.		0.030	
W.S. Elev (ft)	1423.15	Reach Len. (ft)			
Crit W.S. (ft)	1423.15	Flow Area (sq ft)		40.50	
E.G. Slope (ft/ft)	0.016998	Area (sq ft)		40.50	
Q Total (cfs)	163.70	Flow (cfs)		163.70	
Top Width (ft)	81.60	Top Width (ft)		81.60	
Vel Total (ft/s)	4.04	Avg. Vel. (ft/s)		4.04	
Max Chl Dpth (ft)	0.99	Hydr. Depth (ft)		0.50	
Conv. Total (cfs)	1255.6	Conv. (cfs)		1255.6	
Length Wtd. (ft)		Wetted Per. (ft)		81.80	
Min Ch El (ft)	1422.16	Shear (lb/sq ft)		0.53	
Alpha	1.00	Stream Power (lb/ft s)		2.12	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Warning: Slope too steep for slope area to converge during supercritical flow calculations (normal depth is below critical
depth). Water surface set to critical depth.

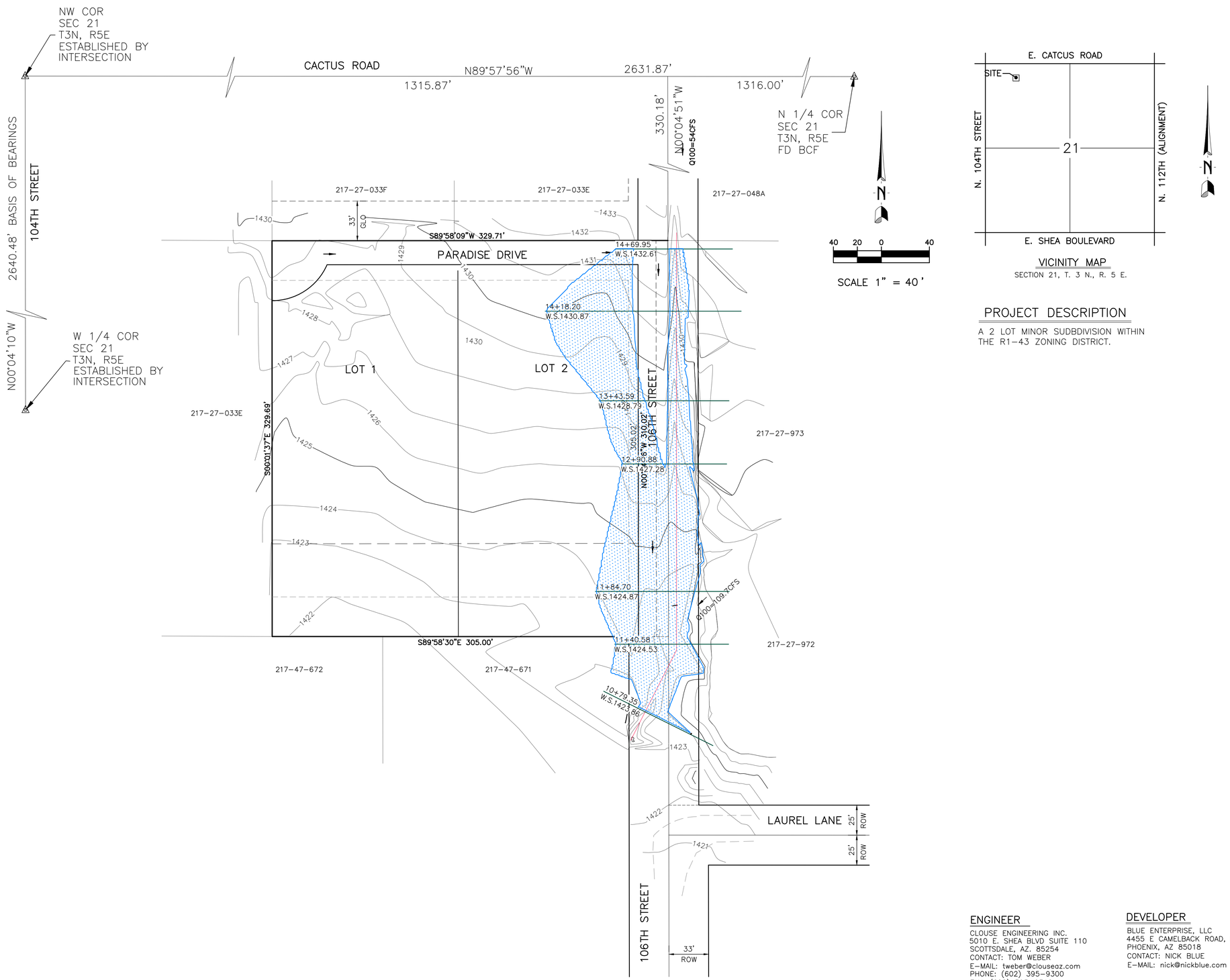
SUMMARY OF MANNING'S N VALUES

River:FINISHED SURFACE

Reach	River Sta.	n1	n2	n3
THALWAG 8-12-20	1469.95	.035	.03	.035
THALWAG 8-12-20	1418.2	.035	.03	.035
THALWAG 8-12-20	1343.59	.035	.03	.035
THALWAG 8-12-20	1290.88	.035	.03	.035
THALWAG 8-12-20	1184.7	.035	.03	.035
THALWAG 8-12-20	1140.78	.035	.03	.035
THALWAG 8-12-20	1078.11	.035	.03	.035

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
THALWAG 8-12-20	1469.95	PF 1	54.00	1430.47	1431.71	1431.71	1431.83	0.026313	2.78	19.39	94.79	1.09
THALWAG 8-12-20	1418.2	PF 1	54.00	1429.19	1430.36	1430.36	1430.46	0.022958	2.54	21.27	107.91	1.01
THALWAG 8-12-20	1343.59	PF 1	54.00	1426.50	1427.39		1427.52	0.009058	2.87	18.83	39.49	0.73
THALWAG 8-12-20	1290.88	PF 1	54.00	1425.71	1426.66	1426.66	1426.79	0.024189	2.91	18.54	79.57	1.06
THALWAG 8-12-20	1184.7	PF 1	54.00	1423.20	1424.41		1424.42	0.000571	0.91	59.21	87.20	0.20
THALWAG 8-12-20	1140.78	PF 1	163.70	1423.00	1424.03	1423.96	1424.26	0.011290	3.80	43.02	69.62	0.85
THALWAG 8-12-20	1078.11	PF 1	163.70	1422.16	1423.15	1423.15	1423.40	0.016998	4.04	40.50	81.60	1.01



VICINITY MAP
SECTION 21, T. 3 N., R. 5 E.

PROJECT DESCRIPTION

A 2 LOT MINOR SUBDIVISION WITHIN THE R1-43 ZONING DISTRICT.

EXISTING CONDITIONS HEC-RAS
10535 E. SHAW BUTTE DRIVE

ENGINEER
CLOUSE ENGINEERING INC.
5010 E. SHEA BLVD SUITE 110
SCOTTSDALE, AZ. 85254
CONTACT: TOM WEBER
E-MAIL: tweber@clouseaz.com
PHONE: (602) 395-9300
FAX: (602) 395-9310

DEVELOPER
BLUE ENTERPRISE, LLC
4455 E CAMELBACK ROAD, D-275'
PHOENIX, AZ 85018
CONTACT: NICK BLUE
E-MAIL: nick@nickblue.com

PRELIMINARY_PLAT.DWG

Clouse Engineering, Inc.
ENGINEERS • SURVEYORS
5010 E. Shea Blvd Suite 110 Scottsdale, AZ. 85254
Tel 602-395-9300 Fax 602-395-9310
ARIZONA
SCOTTSDALE

REGISTERED PROFESSIONAL ENGINEER
CERTIFICATE NO.
35934
THOMAS A.
WEBER
ARIZONA U.S.A.

Revised
5-5-20

Date
3-20-20

As-Built
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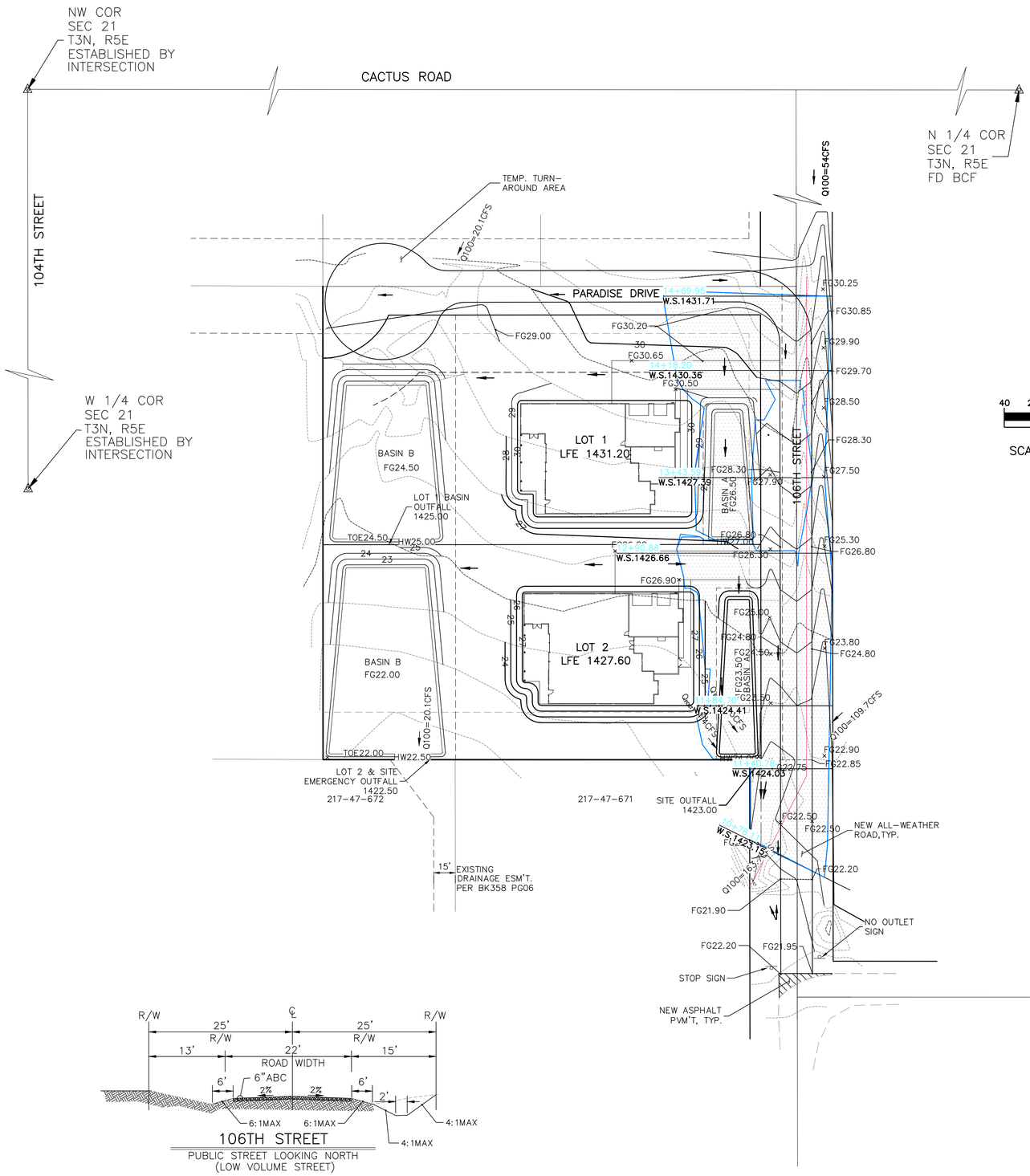
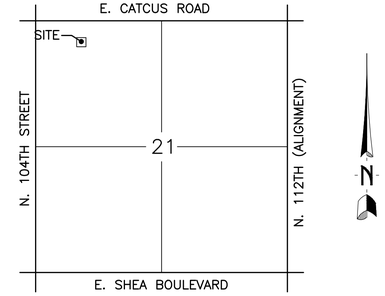
Job No.
-

1 OF 1

664-PA-2019





VICINITY MAP
SECTION 21, T. 3 N., R. 5 E.

106TH STREET
PUBLIC STREET LOOKING NORTH
(LOW VOLUME STREET)

ENGINEER
CLOUSE ENGINEERING INC.
5010 E. SHEA BLVD SUITE 110
SCOTTSDALE, AZ. 85254
CONTACT: TOM WEBER
E-MAIL: tweber@clouseaz.com
PHONE: (602) 395-9300
FAX: (602) 395-9310

DEVELOPER
BLUE ENTERPRISE, LLC
4455 E CAMELBACK ROAD, D-275'
PHOENIX, AZ 85018
CONTACT: NICK BLUE
E-MAIL: nick@nickblue.com

PRELIMINARY_PLAT.DWG

Clouse Engineering, Inc.
ENGINEERS ▪ SURVEYORS
5010 E. Shea Blvd Suite 110 Scottsdale, AZ. 85254
Tel 602-395-9300 Fax 602-395-9310

PROPOSED CONDITIONS HEC-RAS
10535 E. SHAW BUTTE DRIVE

SCOTTSDALE ARIZONA

REGISTERED PROFESSIONAL ENGINEER
CERTIFICATE NO.
35934
THOMAS A.
WEBER
ARIZONA U.S.A.

Revised
5-5-20
9-23-20
11-05-20

Date
3-20-20
As-Built
.
Job No.
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1 OF 1

664-PA-2019